

REMARKS

Claim 1 is amended in order to more clearly define the claimed invention. Claim 6 is amended in order to correct a misspelled word. The Applicants respectfully submit that no new matter is entered. It is believed that this response is fully responsive to the Office Action dated September 7, 2006.

The present invention is a rechargeable battery, having at least one anode, at least one cathode, each cathode being in opposing spaced relationship to each anode. Two layers of differing porous separators/binders are intermediate each opposing anode and cathode to maintain spacing and to bind each anode to each cathode. Non-aqueous electrolyte fill pores of the layers of separator/binder. A first separator/binder comprises a mixture of polymer P₁ and a particulate material M₁ and a second separator/binder comprises a mixture of polymer P₂ and a particulate material M₂. Polymer P₁ is soluble to a degree for forming a polymeric solution in a solvent S₁ and polymer P₂ is soluble to a degree for forming a polymeric solution in a solvent S₂. Also polymer P₁ remains solid in the presence of solvent S₂, polymer P₂ remains solid in the presence of solvent S₁, and particulate material M₁ remains solid in the presence of solvent S₁, and particulate material M₂ remains solid in the presence of solvent S₂. The opposing spaced relationship of each cathode to each anode is maintained by the binding of each anode to each cathode by polymers P₁ and P₂.

The present invention utilizes polymer and solvent solubility relationships to form an electrode stack requiring no external means to keep the rigidity of the stack. Yamashita's invention uses different polymer and solvents to form two layers of separators and uses external means to hold

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the electrode stack together.

Yamashita et al. does not teach how to combine the coated cathode and coated anode to form a battery that does not require external means to maintain the structure of the battery. The meaning of “the obtained positive electrode sheet and the obtained negative electrode sheet were combined” shown in column 31 line 3 of Yamashita et al. means bringing the coated cathode and anode “in contact” only. The object of the present invention is to make a rigid “electrode stack” utilizing the polymer and solvent relationships which are claimed. As disclosed in the present specification, the first polymer layer serves as a separator layer. The second polymer layer serves as a binder layer to bind the coated electrodes. The processing of the second layer does not affect the integrity of the first coated separator layer. This can be achieved only if the solvent utilized for dissolving the second polymer does not dissolve the first polymer layer that has already been coated and dried on one of the electrodes. The importance of the integrity of the first polymer layer is that if the first layer could be dissolved by the solvent of the second polymer solution a short would be possible thus diminishing the significance of insulation of the first polymer layer.

No rigid battery case requirement is an important feature of the present invention. If the coated electrodes were placed “in contact” only as recited in the method of Yamashita et al., a rigid battery case would be necessary in order to prevent displacement of electrodes in the electrode stack. In the present invention, the resultant battery does not need any external force to hold the electrode stack. This is achieved by the use of the binder layer . The binder layer serves as a binder that binds the electrodes and also acts as a second separator layer to fill any possible pinholes present in the first polymer layer. In other words, the binder layer serves as a binder during fabrication and

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becomes another separator layer when dried. The second separator of Yamashita referred to in the Office Action does not have any binding function even though the layers may have been fabricated using different polymer and solvents. Yamashita's invention does not teach how to form a bound electrode stack using the concept of "separator layer" with "binder layer" and the polymer-solvent-particle relationships required for making the present claimed invention.

Moreover, the interface of the two polymer layers is entirely different in the "in contact" method of Yamashita and in the present claimed invention. The electrochemical property is therefore different. In the present invention, no possible loss of contact between the polymer layers can result, thus better contact and constant separation distance between the electrodes is assured. This is distinct from Yamashita's invention since the interface of polymer layers are not necessarily a constant separation distance and the distance can change when slight gassing results during cycling. Owing to the difference in interface structure, better electrochemical properties can be achieved in the present battery even after long term cycling.

Claim 6 is objected to because at line 3 "repetition" is incorrectly spelled.

Claim 6 is amended in order to correct the spelling error. Removal of this objection is respectfully requested.

Claims 1 – 21 are rejected under 35 USC §112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention. Reconsideration and removal of this rejection is respectfully requested.

It is alleged in the Office Action that the term "soluble" and the term "insoluble" in Claim 1 are relative terms which each renders the claim indefinite, and that the terms are not defined by the

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claim, the specification does not provide a standard for ascertaining the requisite degree, and one of ordinary skill in the art would not be reasonably apprised of the scope of the invention.

It is respectfully submitted that the specification does provide a standard for ascertaining the degree of “solubility” and “insolubility”.

For example, at page 9, lines 4 – 8, the degree of solubility is taught, as it is disclosed that: “The separator/binders are applied to the electrodes as a liquid and the method of application is described below. The liquid separators/binders are prepared by dissolving polymers in a solvent to obtain a polymeric solution followed by adding a particulate material to the solution.” (underline added)

At page 13, lines 15 – 20, the degree of insolubility is taught, as it is disclosed that: “Since polymer P₁ is not soluble in the solvent S₂ of polymer P₂, polymer P₁ is not dissolved when placed in contact with the liquid (at least tacky) polymer P₂ in the step shown in Fig. 3c. As a result P₁ remains solid in the uniform layer as applied and thus guarantees the separation between the electrodes.” (underline added)

At page 16, lines 18 – 23, the degree of insolubility is further taught, as it is disclosed that: “The requirements of polymers P1 and P2 of first and second separator/binders 34 and 36, stated above, are especially important in the present method in order that the dried first layer with polymer P1 remains undissolved and maintained at the uniform thickness which was applied in steps 5a and 5b.”(underline added).

Claim 1 is amended in order to more clearly define the degrees of solubility between the polymers and solvents of the claimed invention. The basis for the amendment are found at least at the locations in the specification which are listed above.

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In view of the amendment to Claim 1, removal of this rejection is respectfully requested.

Claims 1 - 3, 5 - 8, 10, 12 - 15, 18 and 20 are rejected under 35 USC §102(b) as being anticipated by WO 97/08763 to Yamashita et al. (U.S. Patent No. 6,287,720). Reconsideration and removal of this rejection is respectfully requested.

Regarding independent Claim 1, it is alleged in the Office Action that Yamashita et al. teaches a rechargeable battery comprising an anode and cathode in opposing spaced relationship to each other and having two intermediate layers of differing porous separators/binders 13A and 13B which are described throughout the reference and in particular in col. 12 line 62 et seq. and col. 13 line 45 et seq and line 58 et seq.

It is respectfully submitted that the present claimed invention is distinct from the battery of Yamashita et al. In the present claimed battery, because of the materials of the battery and the fabricating method used, an opposing spaced relationship of the cathodes and anodes is maintained by the binding provided by polymer P1 and polymer P2 (see detailed remarks on pages 7 – 9). Such maintaining of a spaced relationship by the binding provided by two different polymers having the claimed solubility properties is not found in the battery of Yamashita et al.

Fig. 5 depicts a battery of Yamashita et al. having the alleged separator/binder 13A and 13B between an anode and a cathode, however, polymer P1 is not shown as being bound to polymer P2, as such arrangement is not taught.

As taught throughout Yamashita et al., a casing is relied on to maintain an opposing spaced relationship of cathodes and anodes. The present claimed invention does not require a casing to

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maintain the structure and spacing of the anodes and cathodes as each anode is bound to each cathode by polymers P₁ and P₂.

In view of the amendment to Claim 1 and the above remarks, removal of this rejection is respectfully requested.

Claims 9, 16, 17, 19 and 21 are rejected under 35 USC §103(a) as being unpatentable over WO 97/08763. Reconsideration and removal of this rejection is respectfully requested.

Claims 9, 16, 17, 19 and 21 depend from independent Claim 1, which is discussed above. In view of the amendment to Claim 1, and the above remarks, removal of this rejection is respectfully requested.

Claim 4 is rejected under 35 USC §103(a) as being unpatentable over WO 97/08763 in view of Kawakami et al. (U.S. Patent No. 5,582,931). Reconsideration and removal of this rejection is respectfully requested.

Claim 4 depends from independent Claim 1, which is discussed above. In view of the amendment to Claim 1 and the above remarks, removal of this rejection is respectfully requested.

Claim 11 is rejected under 35 USC. §103(a) as being unpatentable over WO 97/08763 in view of Ohsawa et al. (U.S. Patent No. 5,225,296). Reconsideration and removal of this rejection is respectfully requested.

Claim 11 depends from independent Claim 1, which is discussed above. In view of the

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amendment to Claim 1 and the above remarks, removal of this rejection is respectfully requested.

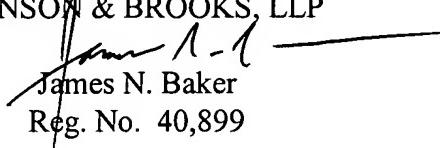
It is believed that Claims 1 – 21 are now in condition for allowance. Allowance of Claims 1 – 21 is respectfully requested.

If there are any issues of a minor nature remaining, the Examiner is urged to contact Applicants' agent, the undersigned, at Area Code (412) 281-2931.

In the event that any fees are due in connection with this paper, please charge our Deposit Account No. 16-0485.

Respectfully submitted,

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